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# MULTIRESOURCE INVENTORIES: INTEGRATING WILDLIFE AND FISH RESOURCES

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# Multiresource Inventories: Integrating Wildlife and Fish Resources

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## Abstract

The capability of an area to produce wildlife and fish can be predicted from a knowledge of species habitat requirements and an inventory of habitat attributes. This species-habitat prediction concept provides a sound conceptual framework for integrating wildlife and fish resources into multiresource inventories or assessments. The principal underlying feature of this concept--identification of habitat variables to be inventoried--serves as its greatest potential source for problems in its application. A demonstration is offered on utilizing the species-habitat prediction concept for integrating faunal resources into multiresource assessments.

## Introduction

The Forest and Rangeland Renewable Resources Planning Act of 1974 (RPA) requires the Secretary of Agriculture to prepare a decadel renewable resource assessment to include an inventory of present and potential renewable resources of the nation's forest and range lands. As a part of this assessment, the Secretary of Agriculture is to develop and maintain a comprehensive and appropriately detailed inventory of all National Forest System lands and renewable resources. The Soil and Water Resources Conservation Act of 1977 (RCA) directed the Secretary of Agriculture to carry out a continuing appraisal

of the soil, water, and related resources of the nation. The Secretary was directed to establish an integrated system capable of using combinations of resource data to satisfy the appraisal objectives. The Federal Land Policy and Management Act of 1976 (FLPMA) requires the Secretary of the Interior to prepare and maintain on a continuing basis an inventory of all public lands and their resource values. The Bureau of Land Management is to rely, to the extent it is available, on this inventory in the development and revision of their land use plans.

Collectively, the cited legislation shares some common themes. First, all require periodic descriptions of the status and condition of America's renewable natural resources. Secondly, each of the agencies assigned a lead role in implementing these mandates are to utilize information and data available from other agencies and organizations so as to avoid duplication and overlap of other planning efforts. Thirdly, wildlife and fish resources are an integral component of the renewable natural resources covered under the scope of this legislation.

There are several methods for assessing the status and production capability of wildlife and fish components of ecosystems--energy flow, habitat quality indices, population inventory and estimation, and a unifying prediction concept which integrates features common to the habitat quality and population estimation methods. The U.S. Fish and Wildlife Service (1980a) examined each of these assessment methods against criteria related to application and implementation of environmental impact assessments. Each of these assessment approaches differed in their ability to meet the identified criteria. The Service concluded that an acceptable assessment method must integrate features common to both the concepts of habitat with its relative ease of implementation and population with its explicit units of measure, or "a land parameter measured in animal units."

The capability of an area to produce wildlife and fish can be predicted from a knowledge of species habitat requirements and an inventory of habitat attributes. Techniques for predicting the occurrence of a species in an area are becoming increasingly visible in the analysis processes being used in renewable resource planning and impact assessment (USDA Forest Service 1981; U.S. Fish and Wildlife Service 1980b).

In their mandated effort to avoid duplication and overlap among planning efforts, federal agencies are increasingly being expected to conduct their wildlife and fish resource assessments and inventories as part of a multi-resource approach. Hirsch et al. (1979) cited two basic factors which contribute to the trend towards multiple-resource inventories. First, trade-offs and interactions among resources produced from a finite land and water base cannot be examined by looking at the various resources as isolated entries; and second, given the increasing amounts of information required for all resource, multiple-resource inventories are more efficient than parallel, but separate, functional efforts. There is currently no fully compatible approach to wildlife and fish inventories among the federal agencies. The diversity of information requirements and user needs within and among agencies will probably continue to constrain the design of one single system to serve all needs. Efforts can be made, however, towards developing and agreeing upon a conceptual framework to guide habitat inventories which would permit the interchange of large amounts of data collected for different purposes. The species-habitat prediction concept cited above, which unites the knowlege of species habitat requirements with an inventory of habitat attributes, provides a sound conceptual framework for integrating wildlife and fish resources into comprehensive ecological inventories or assessments.

refer to Miller's paper for citation of

## Selection of Evaluation Species

A basic prerequisite to employing a species-habitat-prediction methodology is the selection of wildlife and fish species or groups of species to serve as the basis for analysis. A number of approaches for making this selection have been reviewed (U.S. Fish and Wildlife Service 1981) with, as expected, no one approach being favored over another for use by all parties concerned.

In an attempt to increase the ecological perspective of an assessment, a popular selection approach is to pick evaluation species which are representative of a larger community. The U.S. Fish and Wildlife Service (1980b) has outlined several steps in selecting representative species from faunal communities organized by feeding and reproductive guilds:

1. Construction of matrices that define feeding and reproduction guild cells.

Figure 1 shows a three-dimensional matrix which categorizes species according to similarities in breeding and feeding habitat requirements. The decision to employ all or part of the guild cells remains a function of the purpose, time, and funds available for the study.

2. Selection of species that meet guild definitions.

Accounts of individual species habitat relationships must be compiled. These compilations serve as a basis for assigning species within guild categories.

3. Selection of species from each guild.

Since there exists no single definitive way of selecting species for evaluation, a statement of rationale explaining why each species was selected should accompany the assessment.

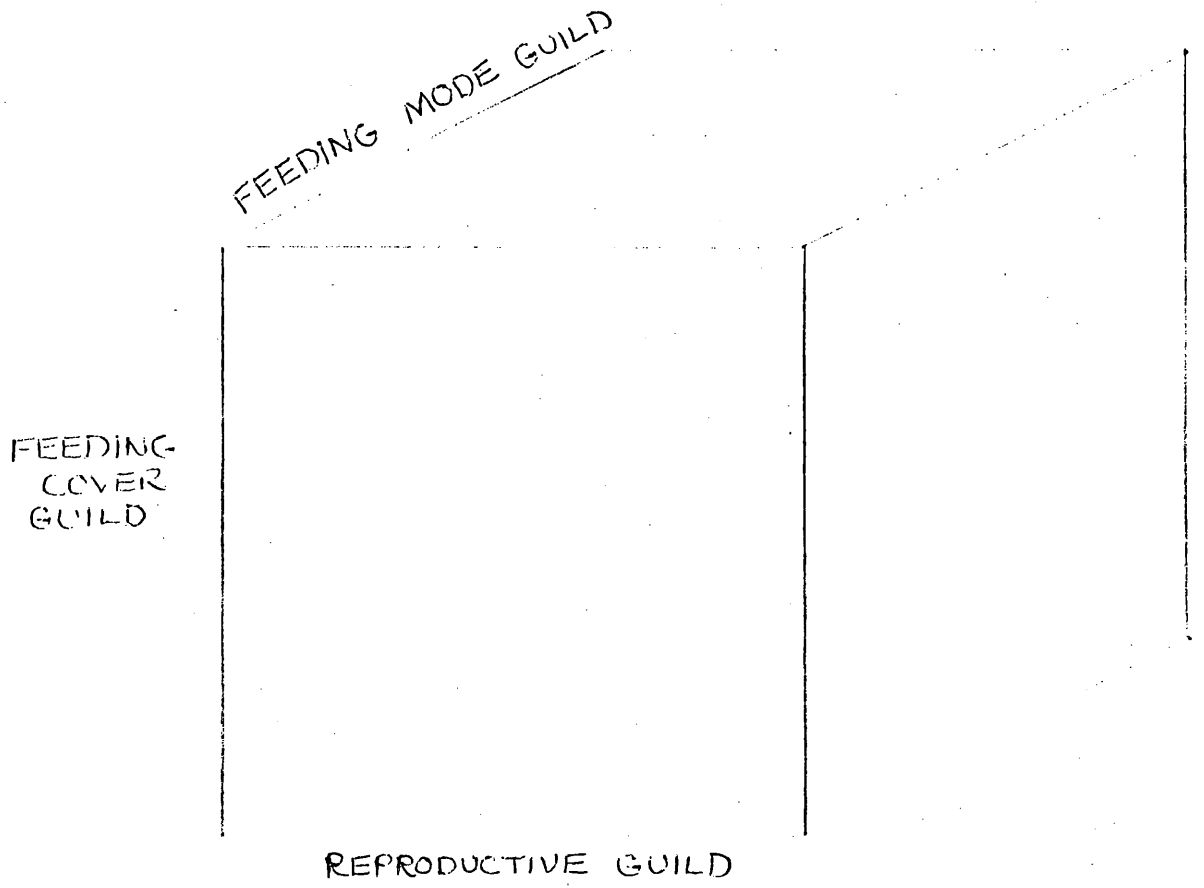


Figure 1.--Reproductive and feeding guilds

## Integration of Habitat Variables Within the Inventory

The first principle in designing any inventory is to develop a comprehensive statement of inventory objective. As part of a demonstration, let us assume that our objective is to integrate an assessment of the availability of wildlife habitat within the USDA Forest Service's periodic Forest Survey for northwestern Oregon (USDA Forest Service 1976). The Forest Survey is a nationwide effort aimed at obtaining information on timber resources to be used as a basis for appraisals of the timber situation in the various states and for the United States as a whole. We will assume that headquarters has agreed with our recommendation to use representative species selected from larger guild communities by which to evaluate habitat availability.

In line with the steps for selecting an evaluation species outlined earlier, we must first determine the guild categories to be used. The life form categories identified by Thomas (1979) for wildlife species in the Blue Mountains province of Oregon will be used in this demonstration. These categories are compatible with the guilding procedure outlined earlier in that feeding and reproduction habitat requirements serve as the basis for delineation in both.

A number of agencies and organizations have established information bases containing compilations on species habitat requirements. We will use the information compiled by the U.S. Fish and Wildlife Service's Western Energy and Land Use Team (WELUT) as our basis for assigning species within guild categories. The information compiled by this group has effectively integrated the data gathered by many sources under one cover and serves as a prescreening mechanism to identify species for which adequate information on habitat requirements is available.

The WELUT habitat summaries applicable to the Williamette-Puget Forest and Pacific Forest Provinces (Bailey 1980) in Oregon were cross-referenced with a species list for northwestern Oregon in developing a refined list of potential evaluation species. Accompanying this refined list of evaluation species, the review allowed identification of 150 habitat variables (both listings available from author on request) for which information would have to be acquired at each survey plot in order to assess its value to all of the wildlife species identified.

A critical step to integrating habitat assessment capability into the inventory is to evaluate the responsiveness of the inventory data elements to the habitat variables of concern. Such a review will determine what additional kinds of quality of information are going to be required.

The objectives of the field measurement and observation part of the basic timber inventory conducted in Oregon were to provide the resource data needed to develop economically and silviculturally sound timber management plans and action programs to meet demands for timber. Therefore, one would not expect a pronounced match-up to exist between the Forest Survey data collected and the habitat variables identified as needed for assessing wildlife resources. In fact, the majority of the habitat variables cannot be satisfied directly from the Forest Survey data. Exceptions to this statement most notably pertain to habitat variables dealing with tree identification and measurement and site physiography.

In some cases where data on hand will not directly satisfy the habitat information requirements, there exist opportunities to utilize a surrogate measurement or observation to meet the need. For example, "slash depth," a required habitat variable, is not directly measured in the Forest Survey. However, the Forest Survey does assign a "ground cover class" value to each site which pertains to the degree that logging slash and debris inhibit natural tree regeneration. Although the variable is not presented in the preferred unit of measurement, the cover class value could certainly provide some information on slash availability that might be easily adapted to the habitat specification of the species of concern.

At the national level, there exist a number of habitat classification methodologies that may prove useful in a wildlife habitat inventory. Much of the cover type terminology appearing among the habitat variables is attributable to the cover type classification system (U.S. Fish and Wildlife Service 1980c) which the U.S. Fish and Wildlife Service employs in developing habitat suitability models. Because of the narrow objective of this classification system, obvious differences exist between it and the ECOCLASS designations employed in the Forest Survey. The definitions accompanying the cover type categories for each system should be examined to determine the degree of cross-referencing that exists between them. The decision as to which cover type classification scheme should be employed must favor the system most responsive to the conditions implied by the variables themselves. That criteria does not "stack-the-deck" necessarily in favor of the Fish and Wildlife Service's system. The habitat variables could be judiciously reworded to fit the terminology of other systems so long as the habitat condition intended for measure or observation remains sufficiently intact.

Another alternative, of course, would be to map the cover type classification system, from which the habitat variables were developed, onto the aerial photos which were originally used in designating Forest Survey photo plots. This unique application of a second cover type classification would provide the vehicle for satisfying a number of habitat variables that pertain to either ratios of various cover types in an area or distances to and/or between cover types. Further development of the classification hierarchy for aquatic systems would be necessary in either case to accommodate aquatic habitat variables. The development and application of an aquatic hierarchy would involve a considerable expense and effort. If this segment of habitat variables were to be dropped, the impact on our ability to assess habitat availability for the life forms included in this assessment would be significant. The evaluation species for life forms 1, 3, and 16 would be eliminated, a significant reduction in evaluation species for life forms 2, 7, and 12 would occur, and a less radical impact would be experienced in life forms 5 and 14.

A number of habitat variables pertain to the distribution of vegetative cover projected vertically within a plant community, the volume of that cover, and the heights of various vegetative strata components within that system. McClure et al. (1979) incorporated such information into a Forest Survey process in the form of a vegetative profile study. When pooled with the tree tally information, these data provide a picture of the horizontal and vertical vegetative structure of an area. The stocking within any defined vertical stratum and/or vegetative type could conceivably be computed for evaluation habitat (Sheffield 1981). A vegetative profile study, designed to be responsive to these habitat variables, would contribute to the assessment of 82% of the total number of evaluation species under consideration in this demonstration.

Another technique for satisfying selected habitat variables involves the integration of data acquired from other inventories into the Forest Survey. Existing maps produced by other organizations might be used by overlaying matching coordinated points (McClure 1979). Habitat variables pertaining to soil conditions could be satisfied from Soil Survey data acquired by the SCS and mapped throughout the Forest Survey area.

Most of the remaining habitat variables require either intensive field data collection efforts to be incorporated into the Forest Survey, or information obtained in essentially final form from other sources (McClure 1979), or require further refinement of their composite inventory data elements. Examples of the latter group are particularly centered on those variables dealing with perch sites, nesting and den sites. An inventory specialist cannot readily react to the term "den site" or "nest site" without additional information which describes the attributes of such a site in detail.

Once the existing inventory content has been reviewed, information gaps identified, and additional information needs delineated, Hoekstra (1981) recommends a reorganization of all habitat variables into a data element list. This is a step to simplify, remove redundancy, and standardize definitions of all data needs required in the multiresource inventory.

The variables identified in the data element standards must be considered as a minimum of input for predicting the availability of habitat for a given species. If the required information regarding a selected variable cannot be made available, then the species associated with that particular habitat requirement should not be included in the assessment. This is an important aspect when reviewing the cost efficiency of acquiring additional habitat information to integrate wildlife and fish into existing inventories. If the costs of obtaining the specified data appear to exceed its intended value, then the other species within the guild should be re-evaluated to determine if a suitable replacement is available. If not, then that particular guild cannot be represented in the assessment.

## Information Processing

The final step in integrating wildlife and fish resources into a multiresource assessment from a common inventory involves the manner in which the data element information will be processed (Hoekstra 1981). The original objective assigned to us was to integrate an assessment of the availability of wildlife habitat in northwestern Oregon into the USDA Forest Survey. We have selected the species to be evaluated and refined our inventory base to be responsiveness to the habitat requirements of those species. Now we must review the data collected at the various inventory sample points and determine whether the characteristics of those sample areas meet the habitat variable requirements for each species.

Sheffield (1981) employed this approach in determining suitable and unsuitable habitat for nongame birds in South Carolina. A FORTRAN program evaluated each Renewable Resources Evaluation (RRE) forest sample in South Carolina for its suitability as breeding habitat for nine bird species. Summary cards for each plot were produced with the rankings and were used in compiling and evaluating the data. Sheffield (1981) offers estimates of the extent, relative condition, and distribution of habitat for each species. A similar approach for Oregon, which is sensitive to the overall Forest Survey design, could certainly be applied to satisfy the assessment objective.

An additional consideration must be applied to wide-ranging species when using this information processing approach. The absolute requirement for all critical habitat variables to be contained within a single field plot may be relaxed if the home range of the species overlaps more than one field plot. In these cases, the specified habitat requirements might be satisfied through the contributions of those adjacent plots falling within the radius of the species home range.

## Conclusion and Recommendations

Several major legislative acts require periodic descriptions of the condition and potential of America's renewable natural resources. Wildlife and fish resources are an integral component of the renewable natural resources covered under the scope of this legislation.

There are several methods for assessing the status and production capability of wildlife and fish components of ecosystems. One method is through a species-habitat prediction approach which unites our knowledge of species habitat requirements with an inventory of habitat attributes. Our demonstration of this approach has provided some insight into the complexity of developing a well-designed wildlife habitat inventory. Many authors, as cited by Gladwin (1981), state a need for coordination between agencies and organizations and standardizations of categories of species information contained in the wildlife dataset. I think that the diversity of information needs within and among agencies may constrain our achieving that most ambitious of goals. However, agreement could be reached on a common conceptual framework to be used in integrating wildlife and fish resources into multiresource inventories. I submit that the species-habitat prediction approach provides that sound framework.

Using this approach, wildlife habitat surveys and/or evaluations can be performed using the specific habitat requirements of a single species, or group of similar species (guilds), or from a review of habitat "quality" for wildlife in general (Barnes and Barnard 1979). The dominant underlying feature of the species-habitat prediction approach also serves as its greatest potential source for problems in its application--identification of habitat variables to be inventoried. When compiling an account of a species habitat needs, one is always faced with the question of how accurate is a given expression of a species

habitat requirements. That question will always be around, but you can minimize its significance by incorporating all of the major variables defined in the literature that are applicable to the geographical and temporal scale of concern. The habitat variables selected must also be reduced to a data element format that can be objectively integrated into an inventory design. A request to inventory potential "nesting sites" would be received with far more confusion by the inventory specialist than a request for the inventory to include "the number of trees or snags with a diameter at breast height greater than 25.4 cm and a total height greater than 5 meters."

The selection of habitat variables and the wording used to express those variables will greatly influence the cover type classification system employed in conjunction with the inventory. A simple exercise of compiling a species habitat summary from a literature review and then cross-referencing the verbage of that account with the terminology offered in many nationally-recognized land and water classification systems will adequately illustrate that point. As many habitat variables are likely to be inherently linked to a cover type classification of some form, it is imperative that the habitat variables either be expressed in terms compatible with the cover type classification system in use or the classification be amended as applicable to capture the habitat specifications identified.

Many agencies are faced with assessment responsibilities regarding wildlife and fish resources that are beyond the present data-supportive capabilities of their present inventories. For example, the USDA Forest Service's Resource Evaluations or Forest Surveys do not provide much information from which to make

an assessment of fish resources. Barnes and Barnard (1979) recognized the restrictive nature of these inventories regarding faunal resource assessment and espoused the need for a more broadly-based multiresource design to include agricultural land and aquatic habitat. That remains certainly as one option, however, with the myriad of inventories conducted today by federal and state agencies alone, some of these blank spots can probably be satisfied with existing data.

If the conceptual framework of the species-habitat prediction approach is acceptable to the inventory designer and if the geographical scale for which prescribed levels of accuracy are desired is also compatible with other inventory data sources, then such data sharing opportunities become highly attractive. For example, if the Forest Survey cannot provide the data for an assessment of waterfowl habitat in Maryland, accurate at the State level, then in lieu of radically modifying the Forest Survey design, a more suitable alternative may be to use data from the National Wetland Inventory (Cowardin et al. 1979), the National Resource Inventory (USDA Soil Conservation Service 1977), or from the Maryland Automated Geographic Information (MAGI) System (Antenucci et al. 1979). Data sharing is not a matter subject to the whims of personal preference or vanity--it is a requirement in most laws which require resource assessments.

This paper has demonstrated an approach for integrating wildlife and fish resources into resource inventories oriented towards other functional objectives. The demonstration was biased towards an inventory designer's viewpoint and only superficially addressed the all important information processing or analysis phase of the process. Information processing remains an area of active research today with much emphasis being directed towards finding ways to integrate wildlife and fish resources within a more comprehensive ecological assessment. The reader is referred to the literature cited under USDA Forest Service (1981) for a review of the state-of-the-art in this subject field and an outline of research activities planned to overcome the shortcomings addressed in this review.

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